Available online at www.sciencedirect.com

SciVerse ScienceDirect

Procedia - Social and Behavioral Sciences 40 (2012) 817 – 829

Procedia
Social and Behavioral Sciences

International Conference on Asia Pacific Business Innovation & Technology Management

Mediate effect of technology innovation capabilities investment capability and firm performance in Vietnam

Ming Lang Tseng [a]* , Sheng Hsiang Lin[b], Truong Nguyen Tuong Vy[b]

Graduate School of Business and Management[a]
, Department of Business Administration[b]
, Lunghwa University of Science and Technology,
No. 300, Sec. 1, Wanshou Rd., Guishan, Taoyuan, Taiwan, 33306,

Abstract

Under the context of globalization and international economic integration today, Vietnam enterprises' existence and development depends on competitive advantage. Technological innovation capabilities (TICs) are the fundamental supports and decisive factors of competitive advantage, the modern enterprise's existence and development depend on the knowledge and technology's innovation and application. Researchers widely recognized that TICs are still limited in Vietnam. Hence, enterprises are required to invest TICs in order to survive and achieve a goal for global market. However, while many assume that the relationship between investment capability and TICs is not clear how investment capability affects TICs, or how to what this relationship affect competitive performance of firm. Therefore, the main of objective of this present study is to understand the way in which investment capability (IT) of the industry on TICs at the level of its firm, affects the efficiency and the potential of Vietnam enterprises that have to gain their competitive advantage. Based on a survey of manufacturing firms in Vietnam, the study identified that Vietnam enterprise are required to invest to enhance seven dimensions of TICs - learning, R&D, resource allocation, manufacturing, market, organizational, and strategic planning capabilities. Moreover, the research utilizes a regression analysis to demonstrate that investment capability can lead directly competitive performance through TICs.

Keywords: innovation, technological innovation capabilities, competitive performance, Vietnam.

* Corresponding author. Tel.: +97150-7249575;
address: prakashvel@uowdubai.ac.ae

doi:10.1016/j.sbspro.2012.03.267

1. Introduction

In the context of globalization and international economic integration today, leadership scholars have recognized that developing countries in Southeast Asian area, such as Vietnam, Thailand, Malaysia, etc., with technological backwardness has seriously threatened their business survival of firms on global competitive market. In order to survive and gain a goal of a competitive victory on global market as well as develop the national economic growth, firms must be innovate (Fenny and Roger, 2001), it is necessary to adopt the continuously demand market to competitive pressures. Since the late 1980s, scholars and researchers have sought to explore the means of innovation by which firms and industries in newly industrialized Asian countries; have narrowed their technological innovation capabilities gap with that of worldwide leading industries as well as have increasingly affirmed their business position and activities on global market. These investigations have described the link between innovation and competitiveness and economic growth (Porter, 1990; Nelson et al., 1993) and the results have been widely described the innovation impact, an extremely important factor in achieving a competitive goal, is the key to build successful competition (Tidd et all.; 2001, Brown; 1997, Davenport and Bibby; 1999). However, the issue of the impact of innovation of firm on competitive performance has seldom been determined.

To be at a disadvantage compared with the competitiveness of enterprises of some countries, scholars have emphasized that technological innovation has been become one of the important factors determine the competitiveness of enterprises of all countries in general, Vietnam enterprises particular. They show that the important relationship of innovations and new technologies for competitiveness and growth is a truism among researchers. However, not all new technologies and innovations performance lead to success a goal competitiveness of firm. Given the manifold types of innovation and technological opportunities from which firms can potentially select, it is desirable to know which innovation activities and technologies are most clearly associated with improved competitiveness and fostered socio-economic growth (Koellinger, 2008). Nonetheless, Vietnam's enterprises still use out of date technology which might have been 3-4 generations in the world. Most companies have been using the technology in the 80s of the last century and research and technological innovation capabilities are very limited (Vu & Hoang, 2010). The approach to advanced technology of the enterprises is very limited. Therefore, focusing on supporting for technological innovation investment innovation is importantly to encourage enterprises to invest mechanism, imported equipment and technology. However, the issue of the impacts of investment of firm on technological innovation capabilities was not paid much attention (Lewicka, 2011). There is lack of studies examining the contextual conditions under which effect occurs or is augmented. Therefore, this study wants to fill the research gap.

Most of the studies have drawn on existing approaches to catch up technological innovation (TI) in the world nowadays. Additionally, many previous papers have presented that TI could bring positive impacts, enhancing the competitiveness of firms (Diericks and Cool, 1989; Guan and Ma, 2003). So far, in order to explore the effect of TICs impact on competitive performance, the dimensions of TICs, such as learning capability (LC), resource allocation capability (RAC), research and development capability (R&DC), manufacturing capability (MFC), marketing capability (MKC), organization capability (OC) and strategic planning capability (SPC) (Guan et al, 2006), etc. are now pursued to bring significant impacts to business and to develop economic growth on developing Southeast Asian countries. Consequently, firms must integrate importance within organization and TI to ensure corporate survival and to enhancing the competitiveness of firms. TICs change multi-dimensional difficulties that involve numerous organizational functions and integration among various factors and it is increasingly winning competitive opportunities of firms. Therefore, TICs has become one of the most attractive and promising areas of study in the field of technological innovation management. However, the TICs of a firm have seldom been determined (Wang et all, 2008). Although Burgelman et al. (2004) proposed TICs as comprehensive set of characteristics of an organization that facilitates and support its TI strategies and previous scholars had paid attention to explore the issues of improving TICs that can be beneficial to firm and leads to enhanced competitiveness, no active discussion has yet taken place on how a firm can interact with TICs to enhance its capacity to innovate and achieve global competitiveness. Therefore, this study wants to fills the research gap.

The main objectives of this study are to present the impact of TICs that can affect the firms' competitive performance; and to understand the managerial implications of this research. This study is organized as follows: Section 2 provides a literature survey on TICs. Section 3 presents the SPSS method, the sample and data collection

and the measurement of construct are used to develop and validate TICs criteria. Section 4 follows the empirical results. In section 5, implications of results are discussed. Concluding remarks and a proposal for future research are presented in section 6.

2. Literature reviews and hypothesis development

Technological innovation is both a process that involves the interaction of many different resources and is a concept that is sufficiently complex, multi-dimensional, and impossible to measure directly (Hansen, 2001; Chiesa et al., 1998; Guan and Ma, 2003).Applying technological investment to build successful technological innovation depends not only on technological capability, but also on other critical capabilities in the areas of R&D, manufacturing, marketing, organization, strategy planning, learning, and resources allocation to enhance competitiveness and to foster the economic growth. Thus, the capability of technological innovation of a firm is reflected by a variety of indicators that cannot be measured by any single-dimension scale (Burgelman et al., 2001; Chiesa et al., 1998; Guan and Ma, 2003). Therefore, this study wants to examine the effects of TICs of three main factors together in order to contribute the significant suggestion for enterprises to gain the competitive goal. This study summarized the literature on three main factors: investment capability, TICs and firm competitive performance.

2.1 Theoretical background

2.1.1 Technological innovation capabilities (TICs)

According to Burgelman et al. (2004), TICs are defined as a comprehensive set of characteristics of an organization that facilitates and supports its technological innovation strategies. TICs are a special asset of an enterprise, which comprises different key areas, such as technology, production, process, knowledge, experiences and organization (Guan and Ma, 2003). Lall (1992) defines TIC as the skills and knowledge needed to effectively absorb, master, and improve existing technologies, and to create new ones. Early research on TICs was mainly concerned with the role of such capabilities in technology transfer form firms in industrialized countries to developing country firms. From previous studies until present studies, these studies of TICs development are relevant to the research in term of providing an overall framework for understanding the importance of such capabilities as a resource for enhancing competitiveness. Therefore, understanding to do successful technological innovation depends on not only technological capability, but it also requires other innovation capabilities in the area of manufacturing, marketing, organization, strategy planning, learning, and resources allocation (Yam et al., 2004; Romijn and Albaladejo, 2002).

Adler and Shenbar (1990) have defined technological innovation capability as consisting of four aspects, including: (1) the capacity of developing new products satisfying market needs; (2) the capacity of applying appropriate process technologies to produce new products; (3) the capacity of developing and adopting new product and process technologies to satisfy future needs and (4)the capacity of responding to accidental technology activities and unexpected opportunities created by competitors. These capabilities have existed in a firm and at corporate level. There would have to be a causal connection between a firm's resources and performance. Thus, improvement of TICs as key firm's beneficial resources can enhance competitiveness through investment.

According to Yam et al. (2004), this study follows an audit framework proposed to investigate the TICs and their impacts on innovation performance in electronics manufacturers. The framework includes seven capability dimensions, namely learning capability; R&D capability; manufacturing capability; marketing capability; resource exploiting capability; organizational capability and strategic capability. A brief description of seven dimensions is given below, and a list of auditing elements and the associated informants are presented in Figure 1. The framework measured TICs in term of seven dimensions:

(1) Learning capability is the capacity to identify, assimilate, and exploit new knowledge essential for a firm's competitive success.

(2) R&D capability refers to a firm's ability to integrate R&D strategy, project implementation, product portfolio management, and R&D expenditure.

(3) Resource allocation capability is the firm's ability to mobilize and expand its technological, human, and financial resources in the innovation process.

(4) Manufacturing capability refers to the ability to transform R&D results into, which meet market needs, in accordance with design request and can also be manufactured in batches.

(5) Marketing capability indicates the capacity to publicize and sell the products on the basis of understanding consumer's current and future needs, customer's access approaches, and competitors' knowledge.
(6) Organizing capability is the capacity to constitute a well-established organizational structure, cultivate organizational culture, coordinate the work of all activities towards shared objectives, and influence the speed of innovation processes through the infrastructure it creates for developmental projects.
(7) Strategic planning capability is the capacity to identify internal strengths and weaknesses and external opportunities and threats, adopt different types of strategies that can adapt to environment

These seven technological innovation capability dimensions constitute the basic components of innovation including technology, production, management and market etc (Burgelman et al, 2001 and Chiesa et al, 1998).

2.1.2 Firm Competitive Performance

There are a variety of performance measurements proposed by the literature examining sources of innovation. Technological innovation clearly plays a critical role in predicting the long-term survival of organizations (Ancona and Cadwell, 1987). Scholars have emphasized the importance of investment into innovation in determining an organization's success and competitiveness (Higgins, 1995; Porter, 1990). Traditionally, only the investment into R&D activities is considered by practitioners to be a major focus of innovation. However, some researchers have found that merely providing heavy investment on R&D activities cannot sustain innovation performance and firm's competitiveness (OECD, 2010, Yam et al., 2004; Guan and Ma, 2003; Souitaris, 2002; Romijin and Albaladelo, 2002). Therefore, this study wanted to fill this research and proposed a novel construct – the relationship between investment capability and firm competitive performance.

2.2 Hypotheses

2.2.1The positive effect of IC on TICs of firms

Investments in TICs have become a dominant part of the capital expenditure budgets manufacturing organization. Managing TICs investments is complex and the implications of decisions are often not well understood. Recently researchers have proposed the use of real options approach to investment decision making being early examples of its application to TICs investment. In this paper, the research goes beyond the analytical tool of investment TICs in Vietnam enterprises.

Hypothesis 1: IC is positively associated with TICs.
Hypothesis 1a: IC is positively associated with learning capability.
Hypothesis 1b: IC is positively associated with R&D capability.
Hypothesis 1c: IC is positively associated with resource allocation capability.
Hypothesis 1d: IC is positively associated with manufacturing capability.
Hypothesis 1e: IC is positively associated with marketing capability.
Hypothesis 1f: IC is positively associated with organizing capability.
Hypothesis 1g: IC is positively associated with strategic planning capability.

2.2.2 The positive effects of TICs on firm competitive performance

The TICs – firm competitive performance relationship, has been widely argued in different literature streams, such as distinctive competencies (Snow and Hrebiniak, 1980, Hitt and Ireland, 1985), the dynamic capabilities approach (Prahalad and Hamel, 1990; Nelson, 1991; Lei et al., 1996; Teece et al., 1997) and the knowledge – based of the firm (Kogut and Zander, 1992; Grant, 1996a, b). These literatures streams, either explicitly or implies that a firm's TICs can be a source of competitive advantage. Nonetheless, the relation between TIC and firm performance is more complex that what is generally assumed. Although many empirical studies have been done (Pakers, 1985; Jaffe, 1986; Henderson and Cockburn, 1994; McCutchen and Swamidass, 1996; Zahra, 1996; Deeds et al., 1997, 1998; DeCarolis and Deeds, 1999), little consensus has developed as to the exact relation between TIC and performance. A key reason of this is the multidimensionality of both concepts – TIC and firm performance.

Many researchers use R&D expenditures, patents or a combination of the two as indicators of firm"s TIC (Pakes, 1985; Jaffe, 1986; McCutchen and Swamidass, 1996; DeCarolis and Deeds, 1999), others used measures such as

citation counts (Deeds et al., 1997, 1998; DeCarolis and Deeds, 1999), absorptive capacity (Cohen & Levinthal, 1990). Additionally, Yam et al. (2004) introduce a framework of TIC which has been used in many studies recently. In this framework, TIC is measured through seven dimensions – learning capability, R&D capability, resource allocation capability, manufacturing capability, marketing capability, organizing capability and strategic planning capability. Thus, the study can say that each of these measured is an indicator of an element of the broad construct of TICs, but none are a comprehensive measure (Coombs & Bierly, 2006). Firm performance can also be measured through different indicators (Clark & Fujimoto, 1991). The measure of firm performance has advantages and disadvantages and each provides researchers with a perspective of success. Thus, this study asserted that TICs had positive influence upon firm competitive performance. However, no research explored the positive influence of TICs of firms upon firm competitive performance. This study proposed a novel construct, to fill this research gap, and posited that TICs of firms had a positive influence upon firm competitive performance. Therefore, this study implied the following hypotheses.

Hypothesis 2: TICs is positively associated with firm competitive performance.
Hypothesis 2a: Learning capability is positively associated with firm competitive performance.
Hypothesis 2b: R&D capability is positively associated with firm competitive performance.
Hypothesis 2c: Resource allocation capability is positively associated with firm competitive performance.
Hypothesis 2d: Manufacturing capability is positively associated with firm competitive performance.
Hypothesis 2e: Marketing capability is positively associated with firm competitive performance.
Hypothesis 2f: Organizing capability is positively associated with firm competitive performance.
Hypothesis 2g: Strategic planning capability is positively associated with firm competitive performance.

2.2.3 The positive effect of IC on firm competitive performance.

According to Lall (1992), IC is defined as skills needed to identify, obtain technology for design, construction and commission of new products/ facilities. The capital requirement of the project, the appropriateness of the scale, technology and selected equipment are determined. The spending that a firm's make in different innovation activities (e.g. in-house R&D, purchasing license and patents etc.) show its commitment to the accumulation of knowledge that will give rises to new products/process or other kinds of innovation. The positive relation between firm's investment in technological innovation and firm performance has been supported by various arguments: it enables firm to achieve greater capability to meet the demands of its changing domestic and international market (Zahra and George, 2002), thus give firm a good performance. It also enables firm to exploit the intangible technological assets, which can be beneficial to the learning process (Xie, 2004). Thus, this study asserted that investment capability had positive influence upon firm competitive performance. However, no research explored the positive influence of investment capability of firms upon firm competitive performance. This study proposed a novel construct, to fill this research gap, and posited that investment capability of firms had a positive influence upon firm competitive performance. Considering these ideas, this study proposes the following hypotheses:

Hypothesis 3: Investment capability is positively associated with firm competitive performance.

Dimension	Criteria	Preference
Investment Capability	1.Purchasing of tangible/ intangible technology (as: machinery and equipment/ as: patent and license)	OCDE-Eurostat (1997)
	2.Conducting organized In-house R&D and contracted R&D activities (sub-contracted R&D and joint R&D activities)	
	3.Knowledge depending (as: training, inviting experts from outside for problem solving, trials, and experiment)	
	4.Improvement of existing product and process technology	
	5.Marketing of new or improved products	
Learning Capability	6.Capacity to assess technologies relevant to firm's business strategy	Guan and Ma (2003)
	7.Work teams encouraged to identify opportunities for improvement	Yam et al (2004)
	8.Understanding firm's core competencies and matching technological capabilities to market needs	Guan et al (2006)
R & D Capability	9.Quality and speed of feedback from manufacturing to design and engineering	Guan and Ma (2003)
	10.Mechanisms for transferring technology from research to product development	Yam et al (2004)
	11.Extent of market and customer feedback into technological the innovation process	Guan et al (2006)
	12.Level of R&D investment in new product	
Resource Allocation Capability	13.Attaching importance to human resource	Guan and Ma (2003)
	14.Programming human resource in phases	Yam et al (2004)
	15.Selecting key personnel in each functional department	Guan et al (2006)
	16.Steady capital supplement in innovation activity	
Manufacturing Capability	17.Ability to transform with the R&D output into production	Guan and Ma (2003)
	18.Effectiveness of applications of advantage of the manufacturing method	Yam et al (2004)
	19.Capability of manufacturing personnel	Guan et al (2006)
Marketing Capability	20.Relationship management with major customers	Guan and Ma (2003)
	21.Knowledge of different market segments	Yam et al (2004)
	22.Highly sales-force efficiency	Guan et al (2006)
	23.Performance of after-sales	
Organization Capability	24.Ability to handle multiple innovation project in parallel	Guan and Ma (2003)
	25.Coordination and cooperation of R&D, marketing and production department	Yam et al (2004)
	26.High-level integration and control of the major functions with the company	Guan et al (2006)
Strategic Planning Capability	27.Ability to identify internal strengths and weakness	Guan and Ma (2003)
	28.Ability to identify external opportunities and threats	Yam et al (2004)
	29.Goal clarity	Guan et al (2006)
	30.Availability of a clear plan – a road map with measurable milestones	
	31.Adaptability and responsiveness of the company to external environment	
Firm Competitive Performance	32.Sales Performance	Yam et al (2004)
	33.Innovation Performance	
	34.Product Performance	

3. Methodology and measurement

The purposed of the present study is to identify the impact of investment capability and TICs on competitive performance of firm. A survey questionnaire was designed. The results give empirical evidences on investment capability and its relationship with TICs and firm competitive performance.

3.1 Technological innovation capabilities in Vietnam

In the past few years, many Vietnam's enterprises have been develop incessantly, put daringly investment in technology innovation, step by step as the imported technology ownership, thence they have created good quality products that enhance competitiveness in both domestic and international market. However, the speed of technological innovation in most enterprises is still slow. For instance, the percentage of using advanced technological innovation of other countries in the Southeast Asian region is high such as 30% in Thailand, 51% in Malaysia, 73% in Singapore and Vietnam's percentage is only 2%, which is slow. Additionally, investment and development for technological innovation of Vietnam's enterprises still have not improved much. In fact, most of 97% Vietnam's enterprises are small and medium enterprises (SEMs). SMEs in Vietnam still use out of date technology which might have been 3-4 generations in the world. Most companies have been using the technology in the 80s of the last century and research and technological innovation capabilities are very limited. The approach to advanced technology of the enterprises is very limited. Moreover, the level of human resources in scientifically innovation and technology management is still limited the professional qualifications at present in Vietnam (Vu & Hoang, 2010). Therefore, the technological innovation capabilities in Vietnam have not thoroughly exploited to improve for enhancing competitive performance of firm as well as fostering economic. No active discussion has yet taken place on how a firm can interact with TICs to enhance its capacity to innovate and achieve global competitiveness and foster economic growth. Therefore, this study wants to fills the research gap.

3.2 Data collection and the sample

Technological innovation is the critical for the competitiveness of all types of manufacturing industries. The unit of analysis in this study was the specialized business and economic level. This research employed an empirical study, which collected data from enterprises in the high-tech manufacturing industry to research the appropriate competitive solution for SMEs in Vietnam. The samples were randomly selected form "The Role of Technology, Investment and Ownership Structure in Productivity Performance of the Manufacturing Sector in Vietnam – BSPS-CIEM project". The respondents of questionnaire are the CEOs or manager of R&D, manufacturing, marketing and organization departments. In order to augment the valid survey response rate, this research contact to each enterprise which is sampled, explain the objects of the study and the questionnaire contents, and confirm necessary explanation of the respondents prior to question mailing. The respondents were asked to return the completed questionnaire within 3 weeks through mailing.

A questionnaire was designed according to previous researches (Yam et al, 2004; Guan and Ma, 2003; Guan, 2002). The mailings of the questionnaire were slightly modified to reflect the understanding of technological innovation in the region according to the pretest discussed below. Afterward, the questionnaire were contingently mailed to 20 CEOs or the managers of R&D, manufacturing, marketing and organization departments in different Vietnam high-tech manufacturing companies and they were asked to fill in the questionnaire and identify the equivocations in terms, meanings and issues in the second pretest. Seven-point Likert-type scale level was used to analyze investment capability and TICs and competitive performance with 1 representing strongly importance and 5 representing strongly unimportant. The subjective measures have been widely used in organizational research (Dess, 1987; Powell and Micallef, 1997; Guan and Ma, 2003).

3.3 Measures

The measurement of the questionnaire items in this study was with "5-point Likert scale" from 1 strongly importance to 5 strongly unimportant. The questionnaire comprised 4 parts. The first part of the questionnaire consisted of the descriptive date of enterprises (including the number of employees, year founded, industry sector, etc.). The second part is the measurement of TICs; the third part is the measurement of firm performance; and the fourth one is the measurement of economics. Giving that developing new constructs or scales of measurement is

complex task, wherever possible this study uses pilot test construct from past empirical studies to ensure their validity and reliability.

In order to detect technological investment capability, the questionnaire asked CEOs or managers about the average proportion of spending made in innovation activities to firm performance. The investment capability is measured by means of "5-point Likert scale" - (1 "strongly important", 5 "strongly unimportant"). These innovation activities are draw upon the Oslo Manual (OCDE-Eurostat, 1997) to detect the technological investment capability, which consists of 5 items: (1) purchasing of tangible/ intangible technology (as: machinery and equipment/ as: patent and license), (2) conducting organized In-house R&D and contracted R&D activities (sub-contracted R&D and joint R&D activities), (3) knowledge depending (as: training, inviting experts from outside for problem solving, trials, and experiment), (4) improvement of existing product and process technology, and (5) marketing of new or improved products.

A review of the prior TICs literature (Christensen, 1995; Chiesa et al., 1996; Yam et al., 2004) suggested that the scale of 27 items employed by Yam et al. (2004) should be used in this study. The authors used a confirmatory factor analysis to validate a Likert-type 5-point scale (1 "strongly important", 5 "strongly unimportant"). As noted earlier, the functional approach used in these prior studies has the advantage of being easy to understand. A pilot study conducted to verify the scales examined seven TICs: learning capability, R&D capability, resource allocation capability, manufacturing capability, marketing capability, organizational capability, and strategic planning capability. A higher score denoted greater strength in the capability concerned.

The study uses a Likert-type 5-point scale of 3 items, such as (1) sales performance, (2) innovation performance, (3) product performance by Yam et al (2004) to measure firm performance (1 "strongly important", 5 "strongly unimportant") asks about the firm performance as compared with that its most direct competitors. These measures are widely adopted in different innovation studies (Fu, 1998; Evangelista et al., 2001; Wan et al., 2003; Guan and Ma, 2003).

4. Result

Table I showed the descriptive statistic of this study. The Cronbach's coefficients of the constructs were shown in Table II. Generally, the minimum requirement of Cronbach's α coefficient is minimum requirement of Cronbach's α coefficient is 0.7 (Hair et al., 1998). It can be observed that the Cronbach's α coefficient of "investment capability" is 0.970; that of "learning capability" is 0.943; that of "R&D capability" is 0.984; that of "resource allocation capability" is 0.962; that of "manufacturing capability" is 0.925; that of "marketing capability" is 0.945; that of "organization capability" is 0.948; that of " strategic planning capability" is 0.976; and that of " firm competitive performance" is 0.887. The Cronbach's α coefficients of all nine constructs are more 0.7. Therefore, the measurement of this study was acceptable in reliability.

Construct	Mean	Standard Deviation	Min.	Max.
IC	4.330	0.623	3.00	5.00
LC	4.2167	0.711	3.00	5.00
R&DC	4.1750	0.877	2.00	5.00
RAC	4.2250	0.810	2.00	5.00
MFC	4.1667	0.798	2.00	5.00
MKC	4.2250	0.617	3.00	5.00
OC	4.3667	0.665	3.00	5.00
SPC	4.290	0.819	2.00	5.00
FP	4.2167	0.604	3.00	5.00

Table I - Descriptive Statistics

Construct	Number of items	Cronbach's α	Remark
IC	5	0.970	Acceptable
LC	3	0.943	Acceptable
R&DC	4	0.984	Acceptable
RAC	4	0.962	Acceptable
MFC	3	0.925	Acceptable
MKC	4	0.945	Acceptable
OC	3	0.948	Acceptable
SPC	5	0.976	Acceptable
FP	3	0.887	Acceptable

Table II – The Cronbach's α coefficient of the constructs

The result of factor analysis in this study was shown in Table III. Every constructs in this study can be classified into only one factor. Moreover, the study referred to the previous literatures to design questionnaire items. Before mailing to the respondents, the scholars were asked to modify the questionnaire in the first pre-test. Then, in the second pre-test the questionnaires were randomly mailed to 20 CEOs or the managers of R&D, manufacturing, marketing and organization departments in different Vietnam high-tech manufacturing companies and they were asked to fill in the questionnaire and identify the equivocations in terms, meanings and issues. Therefore, the measurement of this study is acceptable in content validity.

Construct	Number of items	Number of factors	Accumulation percentage of explained variance (%)
IC	5	1	30.101
LC	3	1	58.214
R&DC	4	1	71.507
RAC	4	1	81.549
MFC	3	1	81.188
MKC	4	1	90.829
OC	3	1	93.437
SPC	5	1	95.888
FP	3	1	97.553

Table III – Factor analysis of this study

Table IV showed the correlation coefficients among the constructs. It can be found from Table IV that investment capability had significantly positive correlations with learning capability, R&D capability, resource allocation capability, manufacturing capability, marketing capability, organizational capability, strategic planning capability and firm competitive performance respectively, whereas there were significantly positive correlations with learning capability, R&D capability, resource allocation capability, manufacturing capability, marketing capability, organizational capability, strategic planning capability and firm competitive performance.

Construct	IC	LC	R&DC	RAC	MFC	MKC	OC	SPC	FP
IC	1								
LC	.883**	1							
R&DC	.827**	.814**	1						
RAC	.876**	.671**	.718**	1					

MFC	.793**	.788**	.920**	.718**	1				
MKC	.816**	.852**	.871**	.702**	.926**	1			
OC	.818**	.700**	.718**	.676**	.737**	.739**	1		
SPC	.879**	.687**	.687**	.970**	.673**	.686**	.715**	1	
FP	.889**	.891**	.925**	.772**	.951**	.955**	.780**	.752**	1

* .Correlation is significant at the 0.05 level (1-tailed). ** .Correlation is significant at the 0.01 level (2-tailed).

Table IV – Correlation coeffecients between the constructs

The results if regression analysis in this study were shown in Table V. In Model I, Model II, Model III, Model IV, Model V, Model VI and Model VII, the results showed investment capability of firms were positively correlated to the types of TICs - learning capability, R&D capability, resource allocation capability, manufacturing capability, marketing capability, organizational capability, and strategic planning capability. Thus, H1a-H1g was supported in this study. In Model VIII, the result showed investment capability, learning capability, R&D capability, resource allocation capability, manufacturing capability, marketing capability, organizational capability, and strategic planning capability of firms were positively correlated to their competitive performance. Therefore, H2a-H2g, and H3 were supported in this study. In addition, this study also verified the TICs - learning capability, R&D capability, resource allocation capability, manufacturing capability, marketing capability, organizational capability, and strategic planning capability – had partial mediation effects between investment capability and firm competitive performance. This research found that investment capability of firm had positive effects on learning capability, R&D capability, and resource allocation capability, manufacturing capability, marketing capability, organizational capability, strategic planning capability and firm competitive performance. Hence, investment in learning capability, R&D capability, resource allocation capability, manufacturing capability, marketing capability, organizational capability, and strategic planning capability was helpful to business.

Dependent Variable	Model I LC	Model II R&DC	Model III RAC	Model IV MFC	Model V MKC	Model VI OC	Model VII SPC	Model IX FP
Independent Variables								
IC	1.007	1.164	1.140	1.016	0.808	0.873	1.155	0.152
TICs								
LC								0.121
R&DC								0.067
RAC								0.010
MFC								0.255
MKC								0.287
OC								0.004
SPC								0.004
R^2	0.779	0.684	0.768	0.629	0.666	0.668	0.772	0.974
Adjusted R^2	0.767	0.666	0.755	0.609	0.647	0.650	0.759	0.956
N	20	20	20	20	20	20	20	20
F	63.462	38.904	59.644	30.539	35.888	36.291	60.896	52.135

Table V – Empirical results of regression analysis

5. Conclusion and implication

Several research studies have presented the need for innovation as a key source of competitive advantage of competitive advantage for organization. In today's competitive environment, the challenges for all businesses

(including SMEs) are not only to innovation in existing new markets, in order to stay in front of competitors. In this study, Vietnam enterprise are required to invest to enhance seven dimensions of TICs - learning, R&D, resource allocation, manufacturing, market, organizational, and strategic planning capabilities. This research proved the existence of a correlation between IC and TICs and the competitive performance. Therefore, this study proposed a novel construct – IC and filled the research gap. This study referred to the classification of TICs by (Guan and Ma, 2003; Yam et all, 2004) to classify TICs into learning, R&D, resource allocation, manufacturing, market, organizational, and strategic planning capabilities to explore the positive effects of IC and firm competitive performance. In addition, this research also explored whether Vietnam enterprises' TICs had partial mediation effects IC and firm competitive performance.

The empirical results of this study showed that investment capability had positive effects on their TICs were positively correlated to their firm competitive performance. Therefore, H1a-H1g, H2a-H2g, H3 were supported in this study. Hence, this research indicated that the more the investments in TICs of firms, while TICs were positively associated with their firm competitive performance. Therefore, investment in TICs was helpful to business competitiveness in Vietnam enterprises. In addition, this research verified TICs had partial medication effects between investment capability and competitive performance of firm.

Referring to the differences in size between big enterprise and SMEs, no great difference was found to distinguish the TICs, which predetermine the performance of categories. This finding emphasized IC plays important role and TICs can cultivate and affect the enterprises of the particular size in a similar way. Therefore, it indicated two meanings: first, there was advantage of firm size for IC in the manufacturing industry of Vietnam; and second, it was imperative for big enterprise and SMEs in the manufacturing of Vietnam to strengthen TICs through investment capability.

This study identified in order to enhance their sustainable development and innovation capability, Vietnam manufacturing enterprises should reconsider their investment, practices, and should determine the gaps and closely relate their TICs to the strategies and the future planning of innovation activities. Thus, Vietnam enterprises should consider a more balanced focus on their TICs development. In addition, this study is focused on the manufacturing industry in Vietnam, so the further studies can focus on other industries or countries and compare with this study. This study verified hypotheses with questionnaire survey, only providing cross-sectional data, so that this study cannot observe the dynamic change of IC in the process of the development TICs of the manufacturing industry in Vietnam through longitudinal data. Therefore, future studies can set forth toward the longitudinal study to find out the differences of IC and TICs in different stages of development of the manufacturing industry in Vietnam Additionally, future research should identify more TICs and examine how these capabilities affect competitive performance, which may contribute significantly to the field of technological innovation management in Vietnam. Finally, this study hopes the research results are beneficial to CEOs, managers, researchers, or governments to contribute to future research on the Vietnam industry

Reference

[1] Adler, P.S and Shenbar, A. (1990), "Adapting your technological base: the organizational challenge", Sloan Management Review, Vol. 25, pp. 25 – 37.

[2] Amabile, T.M., Conti, R., Coon, H., Lazenby, J., and Herron, M. (1996), "Assessing the work environment for Creativity", Academy of Management Journal, 39(5), 1154-1184.

[3] Ancona, D. and Caldwell, D. (1987), "Management issues facing new product teams in high technology companies. In: Advances in Industrial and Labour Relations, JAI Press, Greenwich: 191-221.

[4] Brown, J.S., 1997, "Seeing Differently, Insights on Innovation", Havard Business School Press, Boston, MA.

[5] Burgelman, R., Maidique, M.A., Wheelwright, S. C., 2001. In: Strategic Management of Technology and Innovation. McGraw-Hill, New York, pp. 10-14.

[6] Burgelman, R ., Maidique, M.A., Wheelright, S.C., 2004. In: Strategic Management of Technology and Innovation. McGraw-Hill, New York, pp. 8-12.

[7] Chiesa, V., Coughlan, P., Voss, C.A., 1998, "Development of a technological innovation audit" IEEE Engineering Management Review 26 (2), 64 – 91, Summer.

[8] Christensen, J.F. (1995), "Asset profiles for technological innovation", Research Policy, 24, 727 – 745.
[9] Clark, K., & Fujimoto, T. (1991), "Product Development Performance", Boston: Harvard Business School Press.
[10] Cohen, W.M. and Levinthal, D.A (1990), "Absorptive capacity: A new perspective on learning and innovation", Administrative Science Quarterly, 35, 128-152.
[11] Coombs, J.E., & III, P.E (2006), "Measuring technological capability and performance", R&D management, 36 (4), 421-438.
[12] Davenport, S. and D. Bibby, 1999, "Rethinking a national innovation system: the small country as SME", Technology Analysis & Strategic Management, 32 (2), 241-55.
[13] DeCarolis, D., & Deeds, D. (1999). The impact of stocks and flows of organizational knowledge on firm performance: an empirical investigation of the bio-technology industry. Strategic Management Journal, 20, 953-968.
[14] Deeds, D., DeCarolis, D., & Coombs, J. (1997). The impact of timing and firm capabilities on the amount of capital raised in an initial public offering: evidence from the biotechnology industry. Journal of Business Venturing, 12, 31-46.
[15] Deeds, D., DeCarolis, D., & Coombs, J. (1998). Firm-specific resources and wealth creation in high-technology ventures: evidence form newly public biotechnology firms. Entrepreneurship Theory and Practice, 22, 55-73.
[16] Dess, G., 1987. Consensus in the strategy formulation and organizational performance: Competitors in a fragmented industry. Strategy Management Journal 8, 259 – 277.
[17] Dierickx, I., Cool, K., 1989, "Asset stock accumulation and sustainability of competitive advantage", Management Science 35, 1504 – 1511.
[18] Dierickx, I., Cool, K., 1989, "Asset stock accumulation and sustainability of competitive advantage" Management Science 35, 1504-1511.
[19] Evageslista, R., Perani, G., Rapiti, F. and Archibugi, D. (1997), "Nature and impact of innovation in manufacturing: some evidence from the Italian innovation survey", Research Policy, 26, 521 – 536.
[20] Evangelista, R., Iammarino, S., V., M., & A., S. (2001)," Measuring the regional dimension of innovation: lessons from the Italian Innovation Survey.", Technovation, 21 (11), 733-745.
[21] Feeny S. and M. Rogers, 2001, "Innovation and performance: Benchmarking Australian firms", Working Paper No.7/01, Melbourne Institute.
[22] Fu, J. (1998). Technological Innovation. Beijing (in Chinese).
[23] Grant, R. (1996a). Toward a knowledge-based theory of the firm. Strategic Management Journal , 17, pp. 109-121.
[24] Grant, R. (1996b). Prospering in dynamically-competitive environments: organizational capability as knowledge integration. Organization Science, 7, pp. 375-387.
[25] Guan, J. (2002),"Comparison study of industrial innovation between China and some European countries", Production & Inventory Management Journal, 43 (3), 30 – 46.
[26] Guan, J., Ma N., 2003, "Innovative capability and export performance of Chinese firms", Technovation – The International Journal of Technological Innovation and Entrepreneurship 23, 737 – 747.
[27] Guan, J. C., Yam, R.C.M., Mok, C.K Ma, N., 2006, "A study of the relationship between competitiveness and technological innovation capability based on DEA models", European Journal of Operational Research 170, 971 – 986.
[28] Hansen, J.A., 2001, "Technology innovation indicators, a survey of historical development and current practice". In: Feldman, M.P., Link, A.N. (Eds.), Innovation Policy in the Knowledge-Based Economy, pp. 73 – 103.
[29] Hair, J. F., R. E. Anderson, R. L. Tatham and W.C. Black: 1998, Multivariate Data Analysis (Prentice-Hall, Inc, Upper Saddle River, NJ), pp. 192-193.
[30] Henderson, R., & Cockburn, I. (1994). Measuring competence? Exploring firm effects in pharmaceutical research. Strategic Management Journal, 15, 63-84.
[31] Higgins, J.M.(1995), "Innovate or Evaporate", New Management Publishing Company Inc, New York.
[32] Hitt, M., & Ireland, R. (1985). Corporate distinctive competence, strategy, industry and performance. Strategic Management Journal, 6, pp. 273-293.
[33] Jaffe.A. (1986). Technological opportunity and spillovers of R&D: evidence from firm's patents, profits and market value. American Economic Review, 76, 984-1002.

[34] Koellinger, P., 2008, "The relationship between technology, innovation and firm performance –Empirical evidence from business in Europe", Research Policy, 37, 1317 - 1328.
[35] Kogut, B., & Zander, U. (1992). Knowledge of the firm, combinative capabilities, and the replication of technology. Organization Science, 3, pp. 383-397.
[36] Lall, S. (1992), "Technological capabilities and industrialization", Word Development, 20 (2), 165 – 186.
[37] Lei, D., Hitt, M., & Bettis, R. (s.d.), (1996). Dynamic core competencies through metalearning and strategic context. Journal of Management, 22, pp. 247-267.
[38] Lewicka, D. (2011). *Creating Innovative Attitudes in an Organization – Comparative Analysis of Tools Applied in IBM Poland and ZPAS Group*. Journal of Asia Pacific Business Innovation and Technology Management. Vol. 1, No. 1, p1-12
[39] McCutchen, W., & Swamidass, P. (1996). Effects of R&D expenditures and funding strategies on the market value of biotech firms. Journal of Engineering and Technology Management, 12, 287-299.
[40] Nelson, R. (1991). Why do firms differ, and how does it matter? Strategic Management Journal, 12, pp. 61-74.
[41] Nelson, R., et al., 1993. National Innovation Systems: A comparative Analysis. Oxford University Press, Oxford.
[42] OCDE-Eurostat. (1997). Proposed Guidelines for Collecting and Interpreting. Dans Olso Manuel. Paris: OCDE.
[43] OECD (2010). The OECD Innovation Strategy: Getting a Head Start on Tomorrow. OECD, Paris.
[44] Pakers, A. (1985). On patens, R&D, and the stock market rate of return. Journal of Political Economy, Vol.93, 390-409.
[45] Porter, M.E., 1990. The competitive Advantage of Nations. Free Press, New York, NY.
[46] Powell, T.C., Micallef, A.N., 1997. Information technology as competitive advantage: The role of human, business, and technology resources. Strategy Management Journal 18, 375 – 405.
[47] Prahalad, C., & Hamel, G. (s.d.), (1990). The core competence of the corporation. Harvard Business Review , 68 (3), pp. 79-91.
[48] Romijin, H. and Albaladejo, M. (2002), "Determinants of innovation capability in small electronics and software firms in southeast England", Research Policy, 31, 1053 – 1067.
[49] Scott, S. G. and Bruce, R. A. (1994), "Determinants of Innovation Behavior: A Path Model of Individual Innovation in the Workplace", Academy of management Journal, 37 (3), 580-607.
[50] Snow, C., & Hrebiniak, L. (s.d.), (1980). Strategy, distinctive competence, and organizational performance. Administrative Science Quarterly , 25, pp. 317-355.
[51] Souitairs, V. (2002). Technological trajectories as moderators of firms-level determinant of innovation, Research Policy 31: 877-898.
[52] Tidd, J., J. Bessant, and K. Pavitt,K., 2001, "Managing innovation: Integrating Technological, Market and Organzational Change", Wiley, Bognor Regis.
[53] Vu Xuan Nguyet Hong and Hoang Van Cuong (2010), "Restructuring technological innovation activities in Vietnam", Ministry of Planning and Investment, 1.
[54] Wan, D., Ong, C., & Lee, F. (2003), "Determinants of firm innovation in Singapore", Technovation, 25 (3), 261-273.
[55] Wang, C.,H. Lu, I., Y. and Chen, C., B., 2008, "Evaluating firm technological innovation capability under uncertainty", Journal of Technovation 28, 349-363.
[56] Woodman, R. W., Sawyer, J. E., and Griffin, R. W. (1993),"Toward a theory of organizational creativity", Academy of management review, 18 (2), 293-321.
[57] Xie, W. (2004). Technological learning in China's colour TV industry. Technovation , 24 (6), 499-512.
[58] Yam, R.C.M., Guan, J.C, Pun, K.F and Tang, E.P.Y. 2004, "An audit of technological innovation capabilities in Chinese firms: some empirical findings in Beijing, China", Journal of Research Policy 33, 1123-1140.
[59] Zahra, S., & George, G. (2002). Absorptive capacity: a review, reconceptualization and extension. Academy of Management Review, 27 (2), 185-203.